2019 NASA COST AND SCHEDULE SYMPOSIUM

OBSERVATIONS OF AN OLD COST ESTIMATOR

General Cost and Schedule Research

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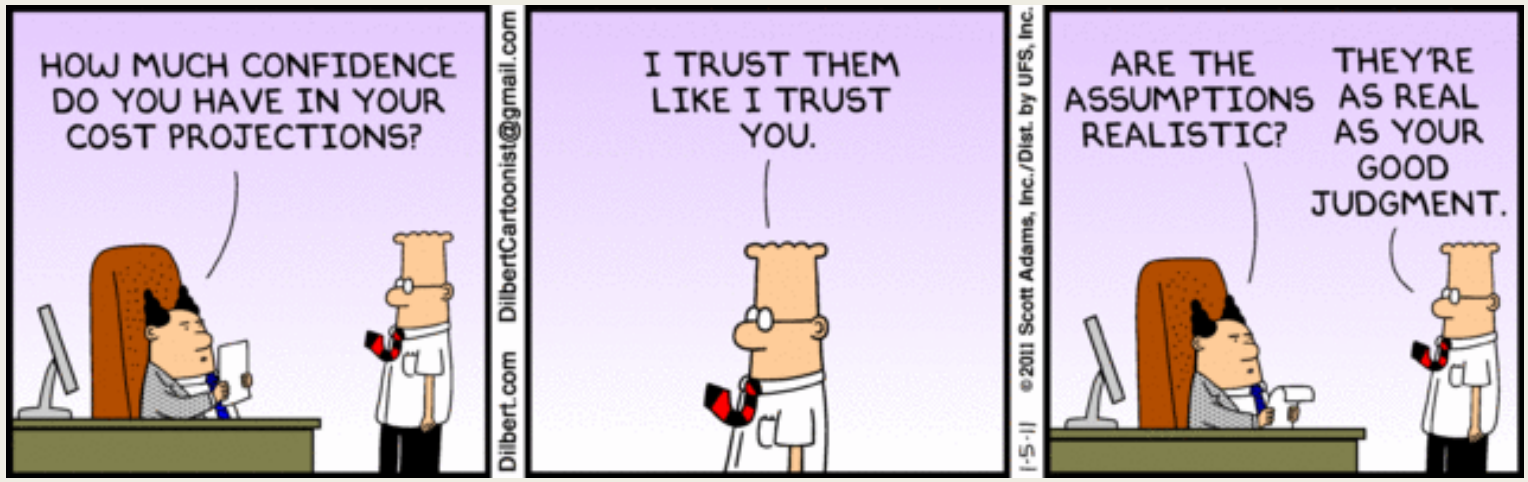
Agenda

- Quotes for the Profession
- Cost Estimating Observations
- You Might be an Old Cost Estimator…
- Suggestions for All Analysts

Quotes for the Cost Analysis Profession

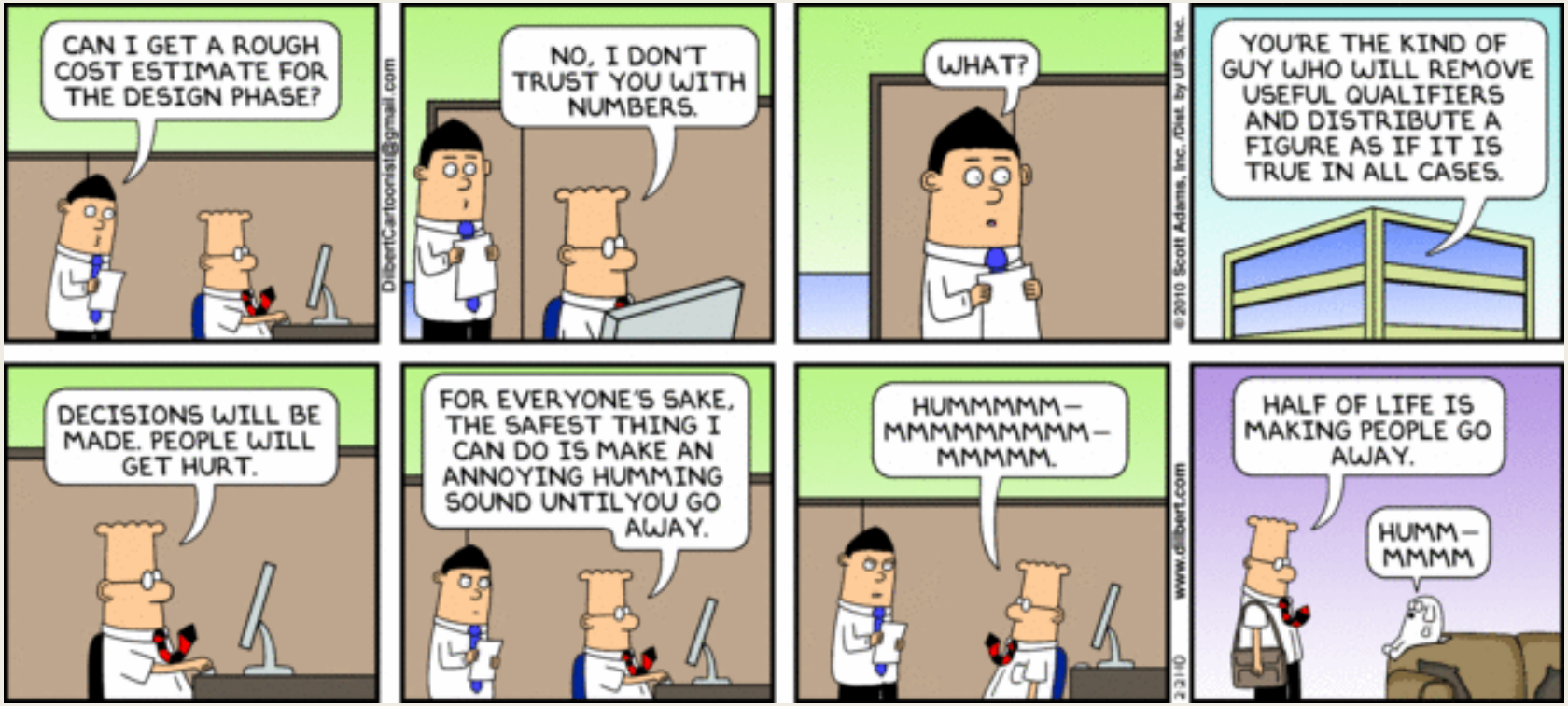
- “Forecasting is very difficult, especially if it’s about the future.” - Mark Twain
- “Statistics: The only science that enables different experts using the same figures to draw different conclusions.” - Evan Esar
- “As far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality.” - Albert Einstein
- “An economist is an expert who will know tomorrow why the things he predicted yesterday didn't happen today.” - Laurence J. Peter

Address Unrealistic Assumptions



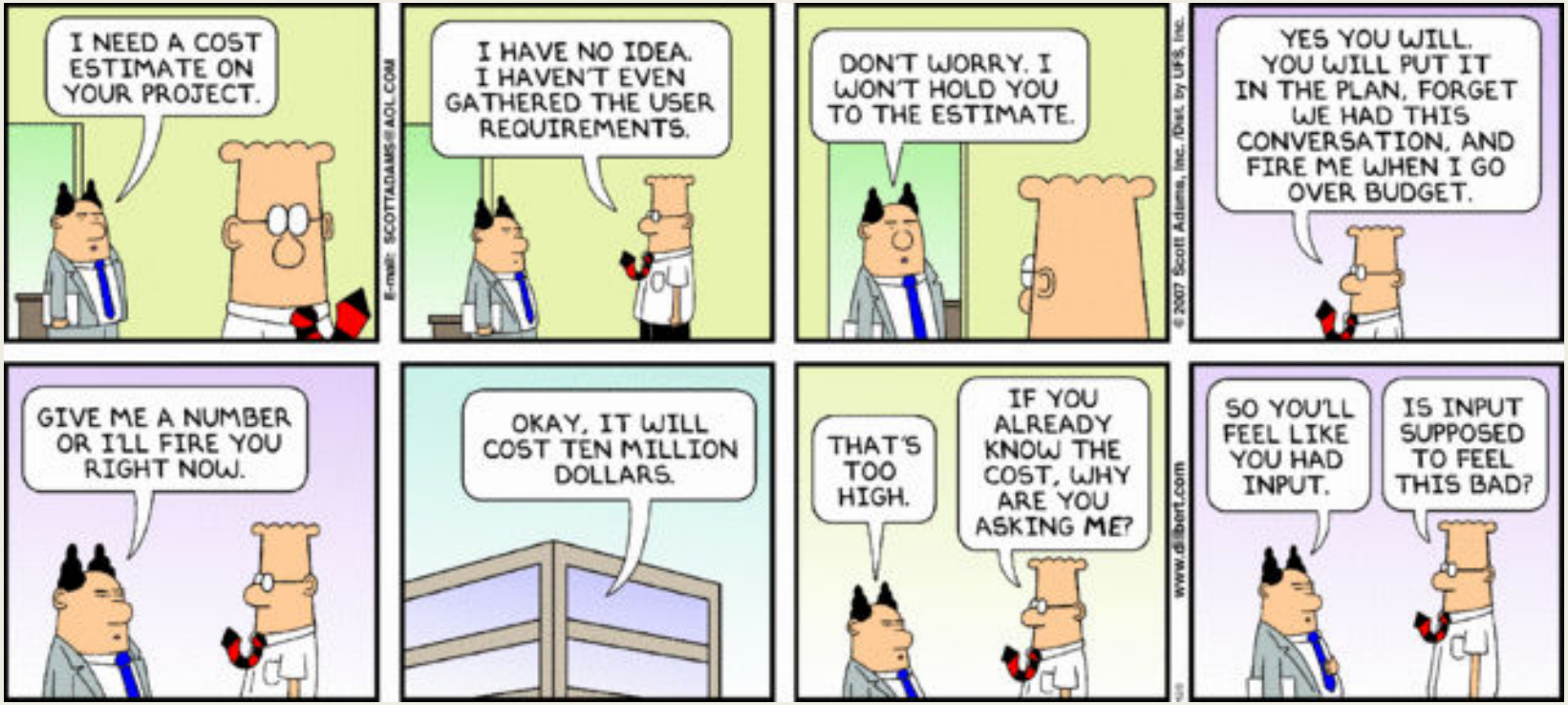
Lesson Learned: *If asked/forced to use unrealistic assumptions, it is recommended to include a corresponding cost and/or schedule risk and calculate necessary cost reserves (UFE) in the estimate package. Make sure your documentation package tells the whole story.*

Protect the Message



Lesson Learned: *In presentations, include key assumptions on the same page as your estimate if needed to protect your message when there is a potential future use of that page in other presentations.*

Initial Impressions Last

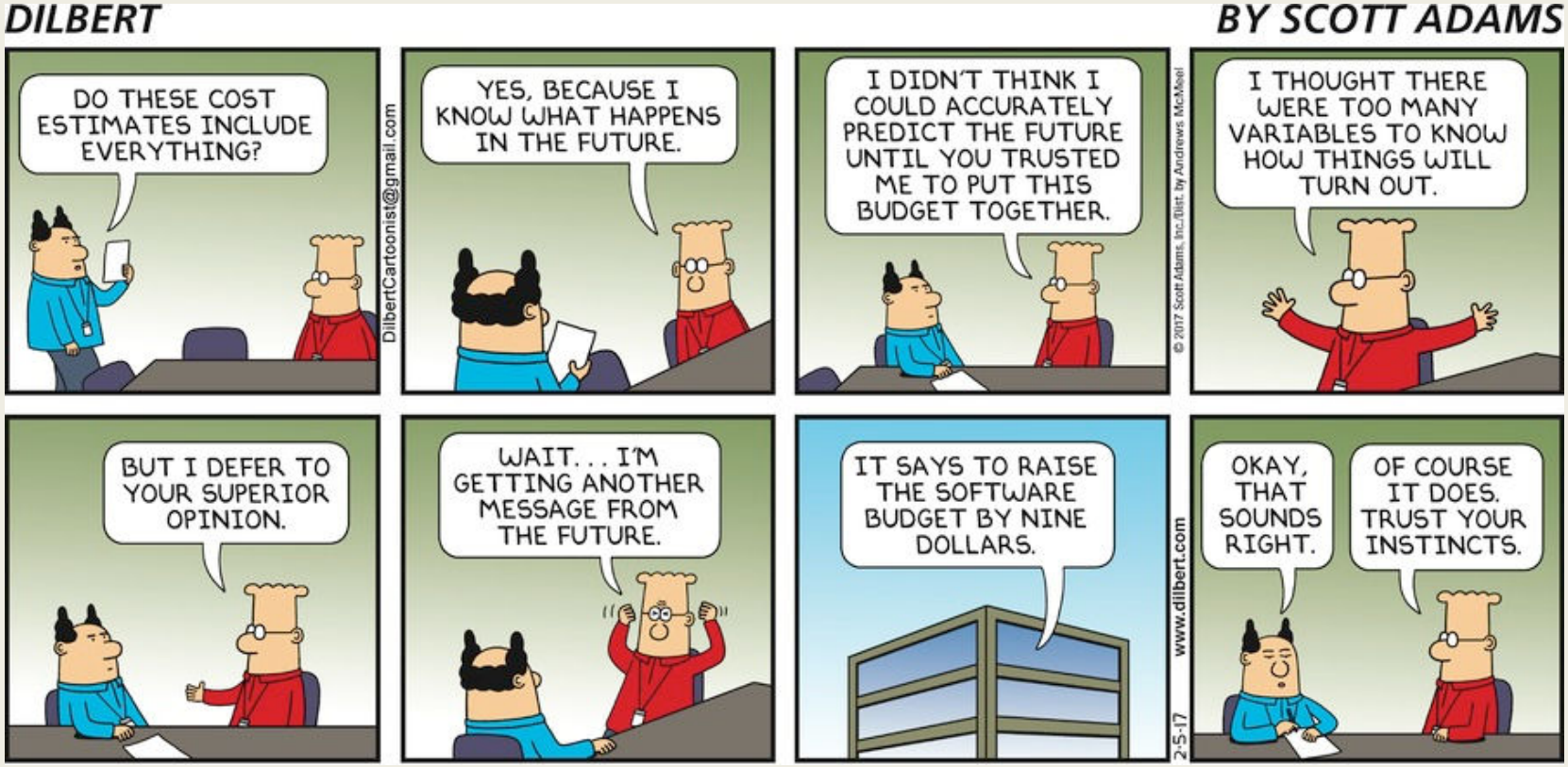


Lesson Learned: *Don't offer initial cost estimates if requirements or a technical description is not provided. If you must, make it a worst case, not-to-exceed number with accompanying key assumptions.*

Fighting “Culture”

Observation: *Many NASA research engineers who started before FY1996 often avoid providing details for planning and estimating. The reduction of directed work and the need to plan to today’s standards is uncomfortable for many of them.*

Impress More Than Your Customer



Observation: *"An ounce of appearance is worth a pound of performance" should be verified when using cost/schedule tools. A good reflection of quality in an estimate package is that it can pass a peer review and is documented at a level to allow an independent estimator to recreate the product.*

Avoid Point Estimates

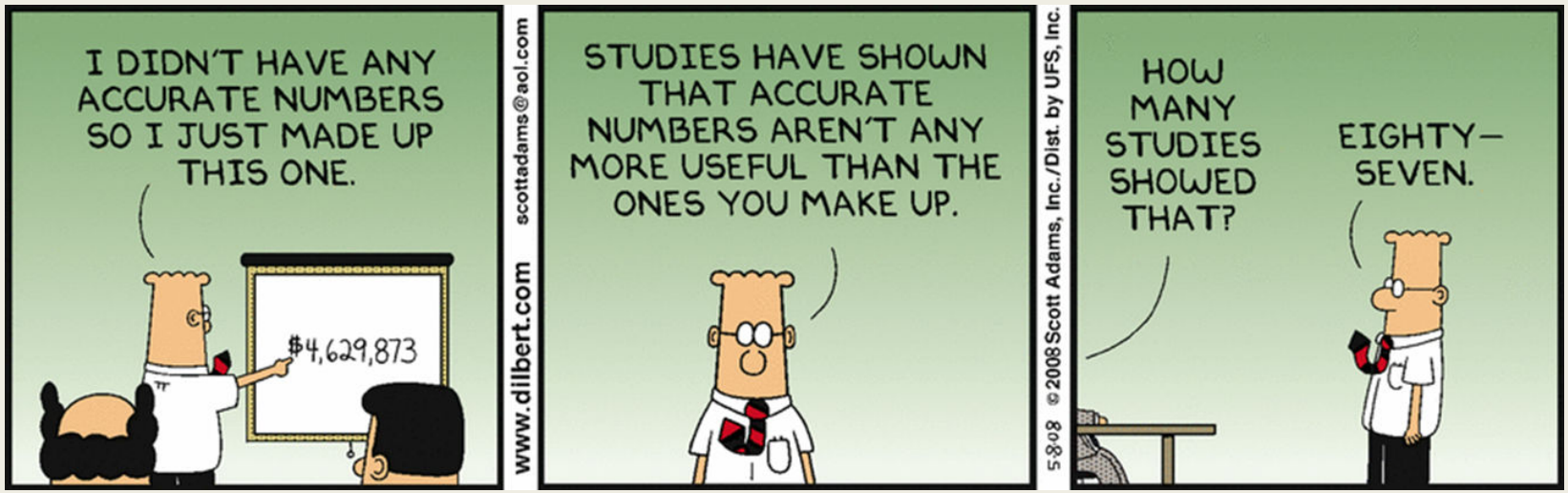
Best Practice/NPR Requirement: Cost and schedule estimates should be risk-informed beginning in Phase A

Using Engineering Estimates

Some experts have no problem providing an estimate…

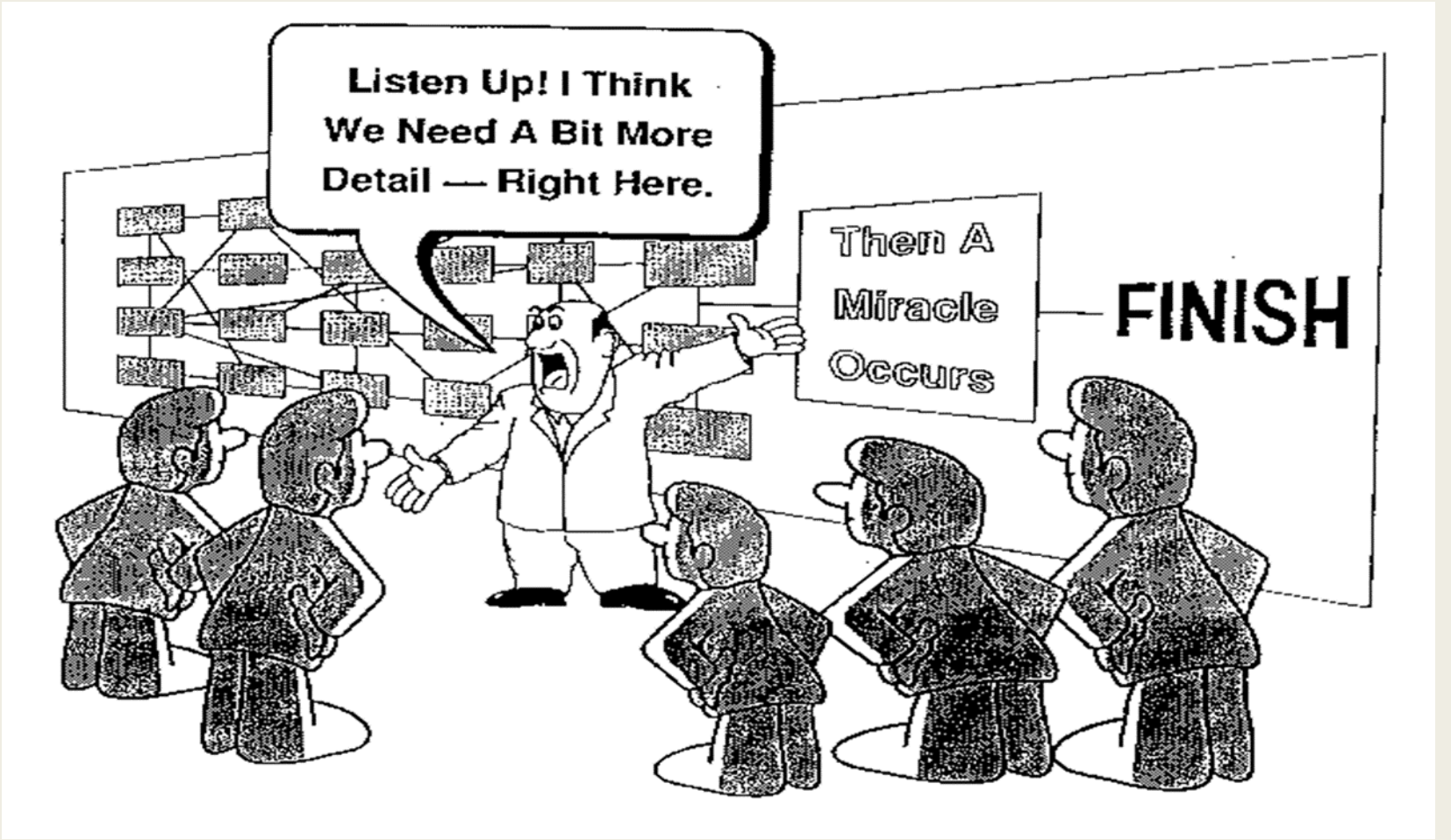
Lesson Learned: *Early project engineering estimates from subject matter experts are often 2-4 times too low.*

Ask For a Basis of Estimate



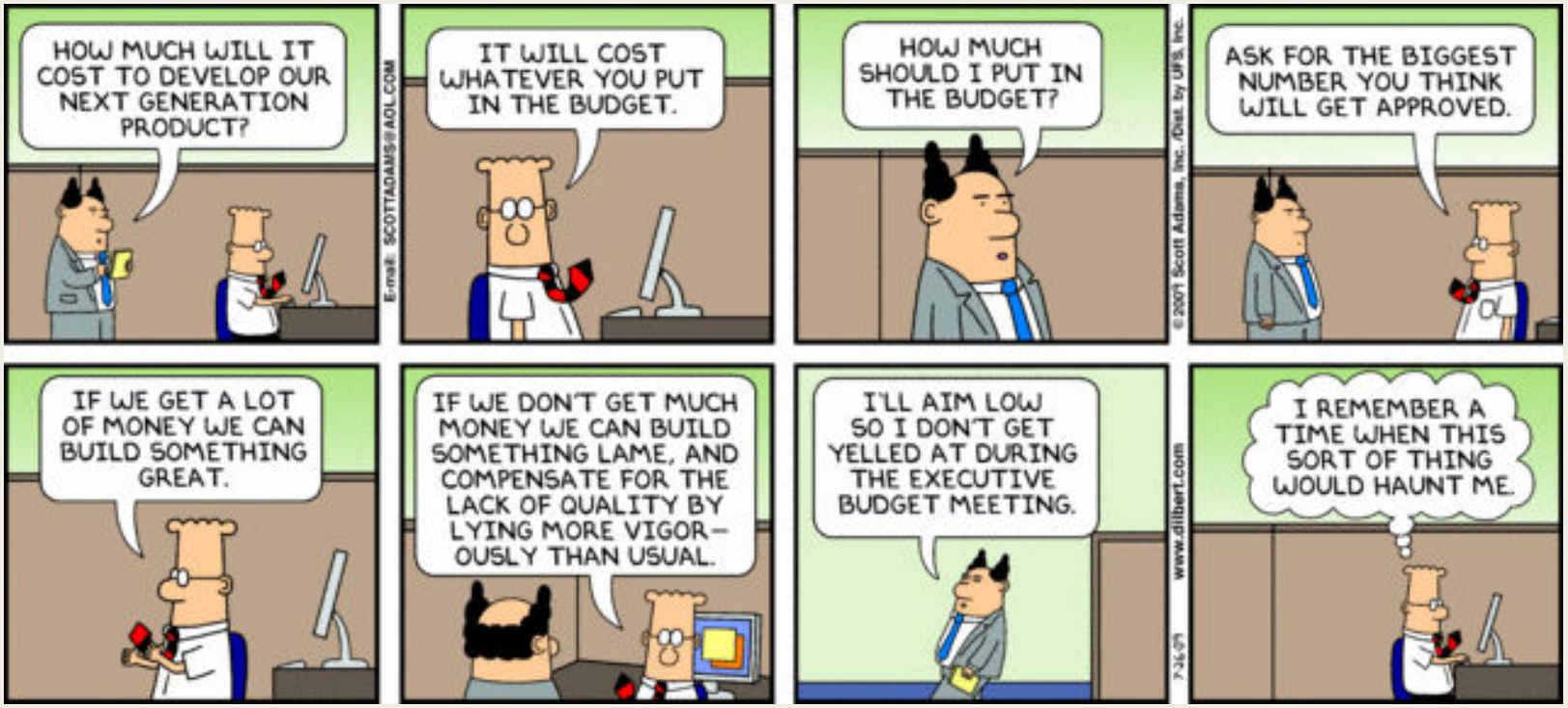
Observation: *Many project hardware procurement engineering estimates are not supported by any real data, historical analogies, or independent parametric estimates.*

Planning to a Fixed Budget



*For research/technology development projects with fixed budgets where the scope for all years may not be well-defined, **planning rigor should be applied for all known scope** with summary planning packages identified for the remaining budget*

Estimating to a Fixed Budget

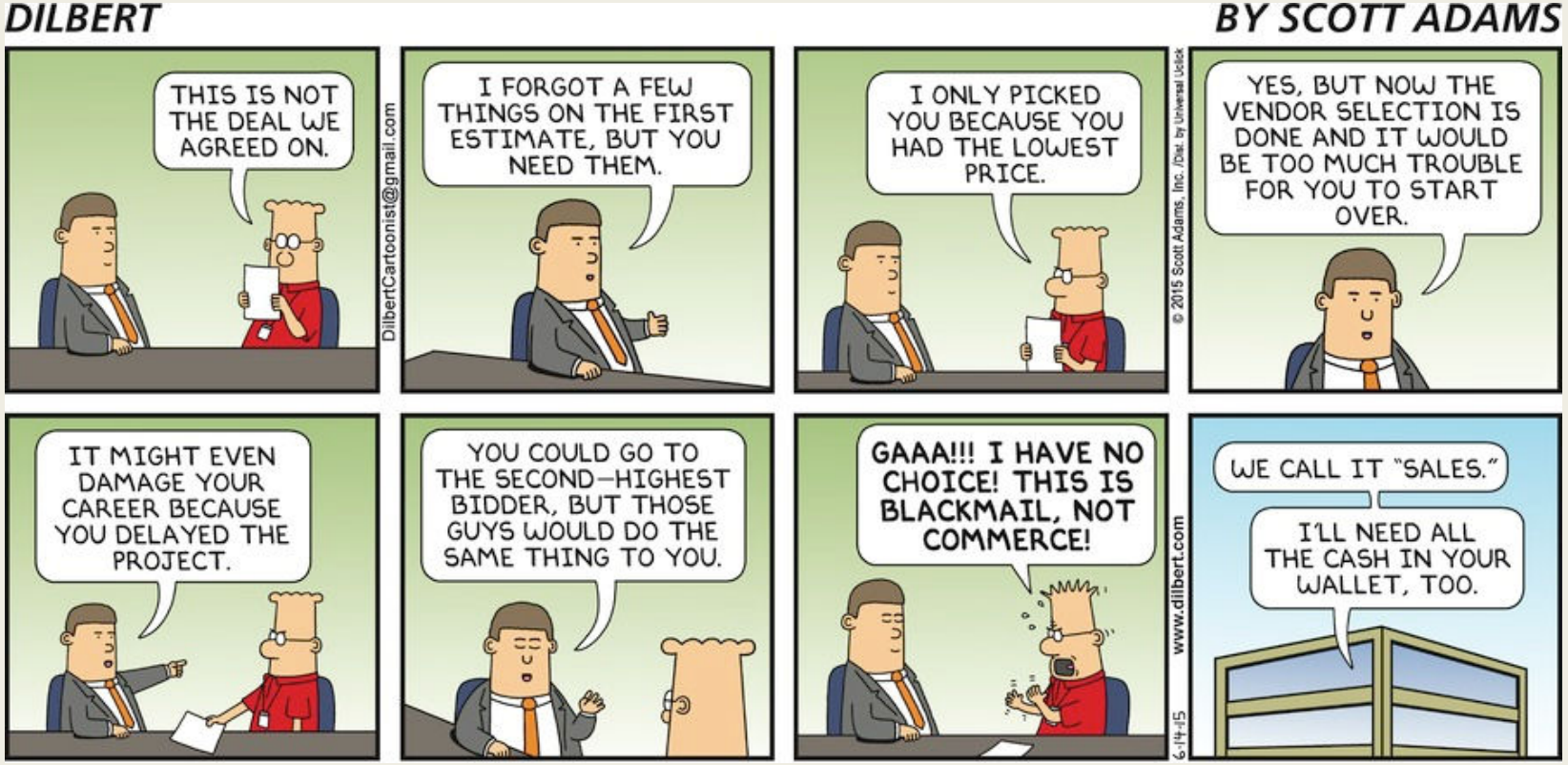


Project estimating to a fixed budget should not change the method or rigor used to prepare the estimate – Detailed planning will allow for easier identification of what work can be accomplished for a given budget

Using Vendor ROMs/RFI Responses

***Lesson Learned**: Use Contractor/Vendor ROM estimates or RFI response estimates with caution in project estimates. Experience shows they are often significantly lower than formal proposal inputs and final actual costs. Differences are greater in sole-source situations.*

Cost Plus/Fixed Price Contracts



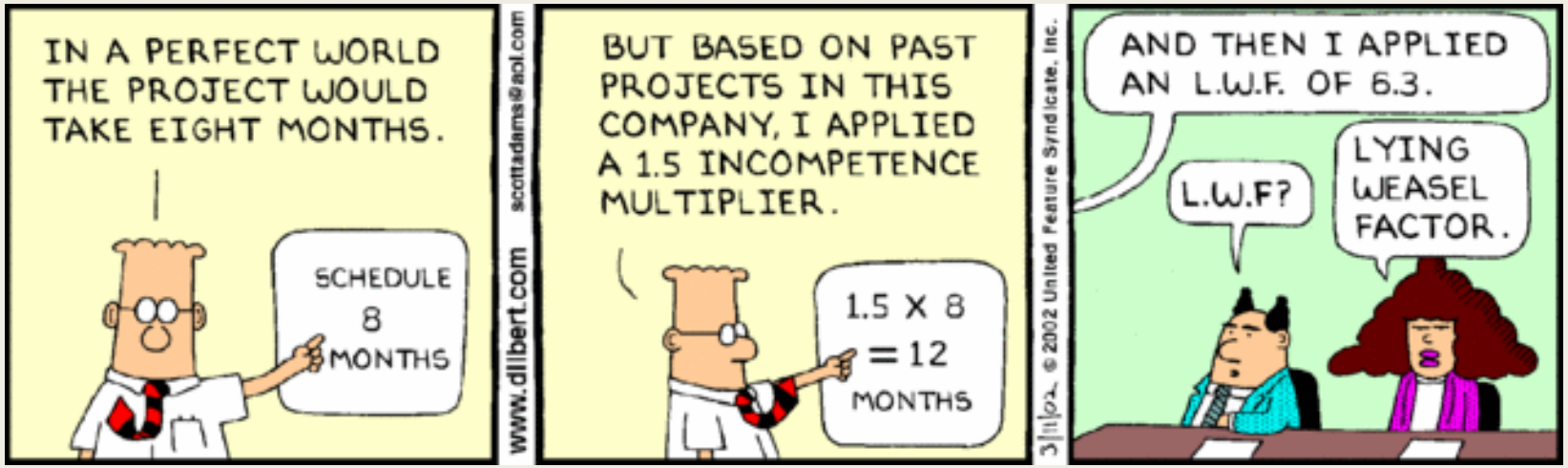
Lesson Learned: *Understand the risk associated with your project's contractor proposal responses (especially fixed price) and factor it into the assessment of project reserves*

Proposal Support Estimating

"Pricing to Win"

Or Not - Try not to get discouraged in the process

Schedule Uncertainty



Observation/NPR Requirement: *Identify and include known schedule risks and uncertainty early in your schedule development process to help assess needs for schedule margin and related cost reserves*

You Might be an Old Cost Estimator if…

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You showed up for your first job after college at a shuttle contractor and they were still talking about the first shuttle launch two months earlier

Your initial use of the PRICE model involved a dial-up modem and careful attention to spaces between your inputs

You Might be an Old Cost Estimator if…

Your initial cost risk tool to determine cost reserves was the HQs Werner Gruhl Risk/Reserve Model

NASA HQ BASELINE DESIGN RISK/RESERVE MODEL

INPUT	PROJECT NAME: SSF		RISK FACTOR	WEIGHT	=	VALUE
PDI	PLANNING DEFINITION INVESTMENT					
	TOTAL DOLLARS INVESTED (TDI) TO DATE:	100				
	TARGET ESTIMATE (TE) AT COMPLETE:	1000				
	TDI/TE RATIO:	10%	3	0.3	=	0.9
DU	DESIGN UNIQUENESS		5	0.2	=	1
HSC	HARDWARE & SOFTWARE COMPLEXITY		5	0.1	=	0.5
SEIT	SYSTEMS ENG / INTEGRATION & TEST DIFFICULTY		5	0.2	=	1
OSC	ORGANIZATIONAL STRUCTURAL COMPLICATIONS		5	0.1	=	0.5
CDR	CONCURRENT DEVELOPMENT REQUIREMENTS		5	0.05	=	0.25
EB	EXPERIENCE BASE (CENTER & CONTRACTOR)		5	0.05	=	0.25
RRS	BASELINE DESIGN RISK/RESERVE SCORE			1.0		4.4

RISK FACTOR GUIDE	HIGH	MEDIUM	LOW
PDI	2%=20	7%=8	10%=3
DU	15	5	3
HSC	15	5	3
SEIT	15	5	3
OSC	10	5	3
CDR	10	5	3
EB	3	5	10

RRS	RESERVE FACTOR	RANGE CONF. LEVEL 84%	95%
0-5	20-25	+10%	+20%
5-6	25-30	+12%	+24%
6-8	30-40	+13%	+26%
8-10	40-50	+15%	+30%
10-13	50-60	+20%	+40%
13-16	60-80	+20%	+40%

RRS SCORE	4.4	
CONVERTED TO RESERVE FACTOR	20	%
RANGE CONF LEVEL (AT 84% OR 95%)	10	%
BASELINE DESIGN RISK/RESERVE PERCENTAGE:	30	%

You've been on the job at NASA for 5 Presidents (3 two-termers), 10 NASA Administrators (including acting), and 7 GRC Center Directors

You Might be an Old Cost Estimator if…

You keep experiencing a feeling of déjà vu:

- *1989 – George H. W. Bush – Space Exploration Initiative – "a journey into tomorrow – a journey to another planet – a manned mission to Mars"*
- *1996 – Bill Clinton – Cancels SEI - "human mission to Mars was too expensive"*
- *2004 – George W. Bush – Vision for Space Exploration – Constellation Program -""we will then be ready to take the next steps of space exploration: human missions to Mars and to worlds beyond"*
- *2010 – Barack Obama – Cancels Constellation Program*
- *2018 – Donald Trump - Space Exploration Initiative – "send American astronauts back to the Moon, and eventually Mars"*

You Might be an Old Cost Estimator if…

You feel comfortable saying what you really think without worrying about the consequences…

Suggestions for All Analysts

- Don't be narrowly focused
  - *Obtain a general knowledge of related fields (cost, schedule, risk, EVM) through project experience, training, self-study, etc.*
  - *Understand what the programmatic requirements are for different types of projects (NPR 7120.X, NPR 7123, etc.)*
  - *Learn about the project technologies involved in your assignments as well as other related NASA projects*
  - *Accept assignments outside your "primary" responsibilities – work proposals, take a detail, work on a Standing Review Board or Source Evaluation Board, etc.*
- Learn the "history" of your Center's projects as well as other projects – ONCE, CADRe, REDSTAR, Center archives (PM/engineer's desks)
- Learn the tools and how to use them properly - GIGO applies to our cost and schedule tools as well
- Continue to "evolve" – Always try to improve upon what you've done or others have done before
- Seek out collaborations with your Center co-workers and peers at other Centers – Don't be afraid to ask for help and let others make you look good